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(71) 出願人 000006286

三菱自動車工業株式会社

東京都港区芝五丁目33番 8 号

(72) 発明者 村田 真一

東京都港区芝五丁目33番 8 号 三菱自動車
工業株式会社内

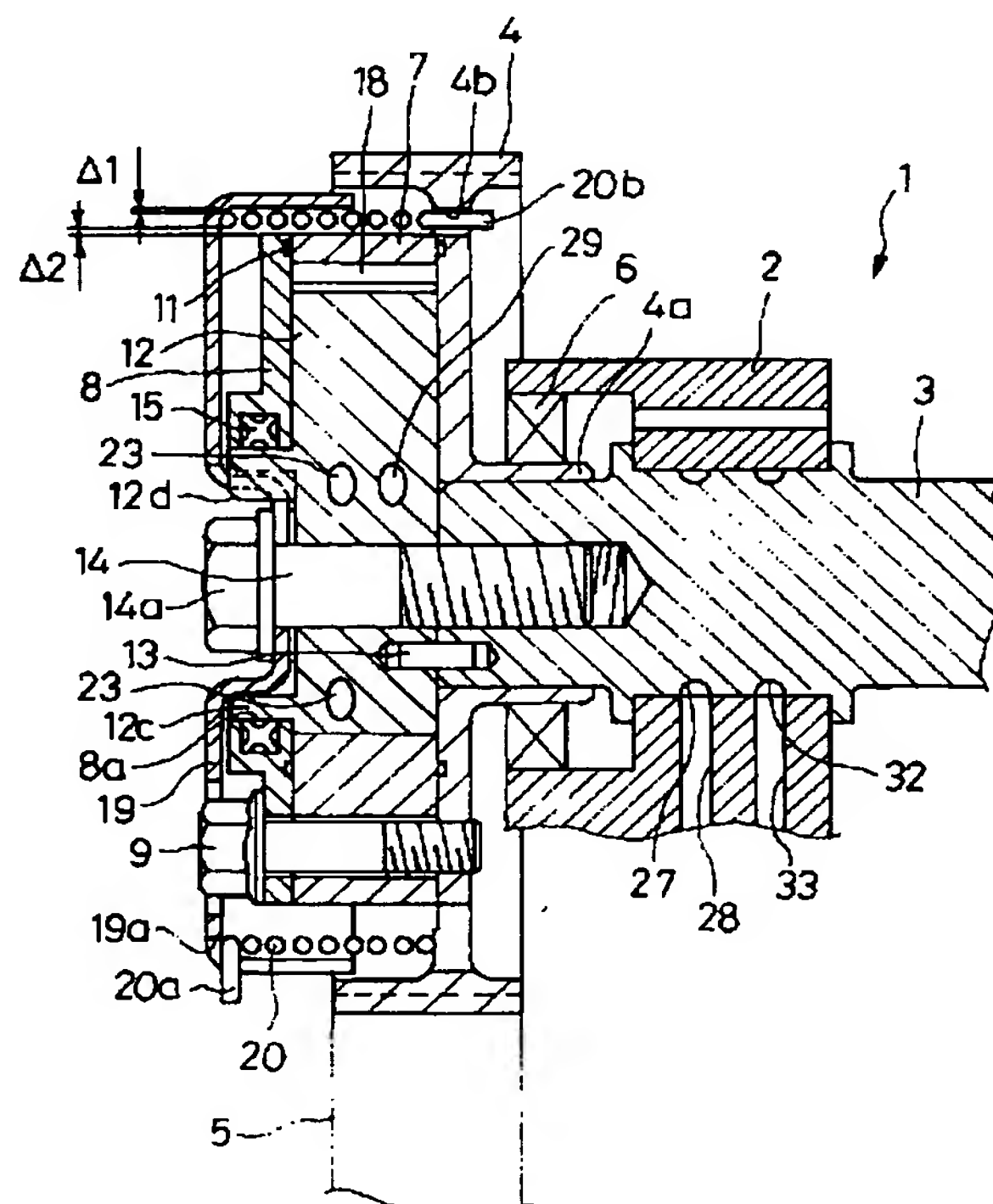
(74) 代理人 弁理士 長門 侃二

(54) 【発明の名称】 カム位相可変装置

(57) 【要約】

【課題】 カムの位相を広範囲にわたって調整できるカム位相可変装置を提供する。

【解決手段】 タイミングプーリ (4) に固定した収容部材 (7) 内にベーン部材 (1 2) を設けてカム (3) と連結し、その収容部材 (7) 外周に捻りばね部材 (2 0) を配設してベーン部材 (1 2) を遅角側に回動付勢し、更に収容部材 (7) 内に形成した油圧室の油圧でベーン部材 (1 2) と共にカム (3) を任意の方向に回動させる。捻りばね部材 (2 0) は収容部材 (7) の外周に位置して径が大きく、かつ十分な巻き数を有するため付勢力の変化が小さく、ベーン部材 (1 2) の回動範囲を広く設定可能となる。



【特許請求の範囲】

【請求項 1】 駆動源により回転駆動される収容部材と、
前記収容部材内の同一軸心上に配設されてカムと一体で収容部材に対して相対回転可能に設けられたベーン部材と、
前記収容部材内に形成されて、内部の油圧によりベーン部材を前記収容部材に対し進角方向又は遅角方向に回転力を付与可能な油圧室と、
前記油圧室に対して作動油を供給する作動油供給手段と、
前記駆動源により回転駆動されるいずれかの部材の外周に軸心方向へ螺旋状をなして配設され、一端が前記ベーン部材側に連結されるとともに他端が前記収容部材側に連結されて、前記油圧室による前記遅角方向への回転力と逆方向にベーン部材を回転付勢する捻りばね部材とを備えたことを特徴とするカム位相可変装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、カムを位相変化させてそのカムにて駆動される機構の動作タイミングを調整可能なカム位相可変装置に関する。

【0002】

【従来技術】 従来のこの種のカム位相可変装置として、例えば、ディーゼル式内燃機関に用いられる燃料噴射ポンプの噴射タイミングを調整する噴射タイミング調整装置を挙げることができる。特開昭 6 0 - 1 7 5 7 3 8 号公報に記載のように、このような調整装置ではクランクシャフトにて回転駆動されるハウジング内に燃料噴射ポンプの入力軸と一体回転するベーンロータを配置し、そのベーンロータを一对の圧縮コイルばねにより遅角側に付勢するとともに、付勢力に抗して油圧により進角側にベーンロータを制御して所望の噴射タイミングを得ている。そして、この調整装置では、ベーンロータとその両側に設けた固定部材との間に前記圧縮コイルばねが介装されて、ベーンロータに付勢力を及ぼすように構成されている。

【0003】

【発明が解決しようとする課題】 しかしながら、従来の噴射タイミング装置ではベーンロータと固定部材との間に制限されて圧縮コイルばねのスプリング長が十分に確保できないため、ベーンロータの回転に伴い付勢力が急変する傾向があった。その結果、ばねの撓み量が最も小さい（付勢力が弱い）最遅角位置においてベーンロータを位置保持できるように比較的大きなばね定数を設定すると、最進角位置での付勢力が過大になって油圧によるベーンロータの回転を妨げてしまい、必然的にベーンロータの回転範囲を広く設定できないという不具合があった。

【0004】 そこで、例えば特開平 5 - 2 9 6 0 1 1 号

公報のように圧縮コイルばねに代えて、より安定した付勢力を発揮する渦巻きばねを用いる提案もなされている。この公報では内燃機関の吸気弁や排気弁の開閉タイミングを運転状態に応じて調整するバルブタイミング調整装置が記載されているが、タイミングプーリの正面にカムシャフトの軸心を中心として渦巻きばねを配設し、その中心端をベーンロータに、外周端をタイミングプーリに掛止して、ベーンロータを付勢している。

【0005】 ところが、周知のように渦巻きばねは半径方向に曲率を次第に変化させながら巻回成形するため製造し難く、均一なばね定数を得るには厳密な品質管理を要して製造コストが高騰するという不具合があった。また、撓み量の増減に伴って巻回部分の線間距離が変化し易く、それが高回転時の遠心力で助長されて重心が偏ってしまう。したがって、回転バランスの悪化による種々の弊害、例えば、カムシャフト軸受部のフリクション増大や焼付き、或いはカムシャフトの回転変動による機関の不調や振動発生等を発生させる虞があった。

【0006】 本発明の目的は、カムの位相を広範囲にわたって調整できるとともに、安価なコストで製造でき、かつ回転バランスの悪化による種々の弊害を未然に防止することができるカム位相可変装置を提供することにある。

【0007】

【課題を解決するための手段】 上記目的を達成するため、本発明では、駆動源により回転駆動される収容部材内にカムと一体で回転するベーン部材を配設し、この収容部材やカム等の回転駆動される部材のいずれかの外周に捻りばね部材を配設してベーン部材を回転付勢するとともに、収容部材内に形成した油圧室の油圧でベーン部材に逆方向の回転力を付与して、ベーン部材と共にカムを回転させる。そして、このように捻りばね部材が収容部材やカム等の外周に設けられてある程度の径を有しているため、付勢力の変化が小さくなってベーン部材の回転範囲を広く設定可能となり、更に、捻りばね部材は軸心方向に巻回成形することから均一なばね定数が得られ、かつ、撓みに伴う重心の偏りがない。

【0008】 本発明は、好適には内燃機関の吸気弁や排気弁の開閉タイミングを調整するバルブタイミング調整装置として具体化することができる。即ち、本発明によれば、内燃機関のクランクシャフトにより回転駆動される収容部材と、前記収容部材内の同一軸心上に配設されて弁開閉用のカムシャフトと一体で収容部材に対して相対回転可能に設けられたベーン部材と、前記収容部材内に形成されて、内部の油圧によりベーン部材に特定方向に回転力を付与可能な油圧室と、前記油圧室に対して作動油を供給する作動油供給手段と、前記クランクシャフトにより回転駆動されるいずれかの部材の外周に軸心方向へ螺旋状をなして配設され、一端が前記ベーン部材側に連結されるとともに他端が前記収容部材側に連結され

て、前記油圧室による回転力と逆方向にベーン部材を回転付勢する捻りばね部材とを備えたことを特徴とするバルブタイミング調整装置が提供される。

【0009】

【発明の実施の形態】（第一実施例）以下、本発明を内燃機関の吸気弁の開閉タイミングを調整するバルブタイミング調整装置に具体化した第一実施例を説明する。図1及び図2に示すように、内燃機関のシリンダヘッド1の軸受部2にはカムとしての吸気側のカムシャフト3が回転可能かつ軸方向に移動不能に支持され、カムシャフト3の回転に伴って各気筒の図示しない吸気弁が開閉駆動されるようになってる。カムシャフト3の前端はシリンダヘッド1から側方に突出してタイミングプーリ4のボス部4aが回転可能に嵌め込まれ、このタイミングプーリ4はタイミングベルト5を介して駆動源としての図示しないクランクシャフトに連結されて、カムシャフト3の軸心を中心として図1の矢印方向に回転駆動される。図示はしないがタイミングベルト5には排気側のタイミングプーリも連結されて、排気側のカムシャフトにて排気弁が開閉駆動されるようになっている。尚、タイミングプーリ4のボス部4aと軸受部2との間にはオイルシール6が嵌め込まれ、シリンダヘッド1から外部へのオイルの流出を防止している。

【0010】タイミングプーリ4の一側面には、收容部材としての略円筒状のハウジング7と円盤状のフロントカバー8とがボルト9により固定され、その内部にカムシャフト3の軸心を中心とした略十字状の油圧室10が形成されて、Oリング11により油密を保持されている。油圧室10内にはベーン部材としてのベーンロータ12が配置され、その中心部はカムシャフト3の前端にノックピン13で位置決めされてカムボルト14で固定されている。

【0011】ベーンロータ12は4つのベーン12aを90度間隔で備え、各ベーン12aの間には油圧室10の固定摺接面10aに当接する円弧状の可動摺接面12bが形成され、それぞれのベーン12aの先端にはオイルシール18が設けられている。これらの摺接面10a、12bにより油圧室10は各ベーン12aに対応して4つに区画され、各油圧室10内においてベーン12aの両側には遅角油圧室17aと油圧室としての進角油圧室17bとが形成されている。

【0012】そして、ベーンロータ12は、図1に実線で示すように各ベーン12aの一侧を油圧室10の内壁に当接させて遅角油圧室17aの容積を最大とする最遅角位置と、仮想線で示すように各ベーン12aの他側を油圧室10の他方の内壁に当接させて進角油圧室17bの容積を最大とする最進角位置との間で、カムシャフト3の軸心を中心として回転し得る。その結果、タイミングプーリ4に対するカムシャフト3の位相が変化して、吸気弁の開閉タイミングが変更される。尚、排気側には

このようなバルブタイミング調整装置が備えられていないため、排気弁の開閉タイミングは固定されたままである。

【0013】ベーンロータ12にはカムボルト14の頭部14aを取り囲む環状シール部12cが一体形成され、そのシール部12cはフロントカバー8に貫設されたシール孔8a内に回転可能に嵌め込まれて、Xリング15により油密を保持されている。フロントカバー8にはばねカバー19が側方より重ねられ、ばねカバー19の中心部はベーンロータ12の環状シール部12cの中央に前記カムボルト14で共締めされるとともに、環状シール部12cに形成された位置決め突部12dにて回転を規制されている。

【0014】ばねカバー19は有底円筒状をなしてフロントカバー8とハウジング7を外部より隠蔽し、ばねカバー19の内周とハウジング7の外周との間には捻りばね部材としての捻りコイルばね20が配設されている。捻りコイルばね20はカムシャフト3の軸心方向へ同一径で螺旋状に巻回されており、この捻りコイルばね20、ハウジング7及びばねカバー19の軸心はカムシャフト3の軸心と一致している。捻りコイルばね20の一端20aはばねカバー19の掛止溝19a内に掛け止めされ、他端20bは前記タイミングプーリ4の掛止孔4b内に掛け止めされ、その付勢力によりばねカバー19と共にベーンロータ12は常に図1に実線で示す最遅角位置側に付勢されている。

【0015】尚、捻りコイルばね20は撓みに伴って若干外径を変化させる性質を有するが、本実施例では、撓み量が最小で捻りコイルばね20が最も拡張したときでも、ばねカバー19の内周との間に微小な間隔Δ1が確保され、逆に撓み量が最大で捻りコイルばね20が最も縮径したときでも、ハウジング7の外周との間に微小な間隔Δ2が確保されるように、ばねカバー19の内径とハウジング7の外径とが設定されている。

【0016】一方、ばねカバー19の一側にはバランス調整孔21が形成されており、バルブタイミング調整装置をカムシャフト3にカムボルト14で連結した状態、つまりシリンダヘッド1への組付け前のアセンブリ状態で、このバランス調整孔21にてバランス調整が行われている。図1及び図3に示すように、ベーンロータ12には一端がそれぞれ進角油圧室17b内に開口する4本の進角導入油路23が形成され、各進角導入油路23の他端は第一油路25及び第二油路26を介してカムシャフト3の外周全周に形成されたオイル溝27内に開口し、前記軸受部2に形成された進角供給油路28に対してカムシャフト3の回転角度に拘わらず常に連通している。

【0017】同様に、ベーンロータ12には一端がそれぞれ遅角油圧室17a内に開口する4本の遅角導入油路29が形成され、各遅角導入油路29の他端は第三油路

3 0 及び第四油路 3 1 を介してカムシャフト 3 のオイル溝 3 2 内に開口し、軸受部 2 に形成された遅角供給油路 3 3 に対してカムシャフト 3 の回転角度に拘わらず常に連通している。

【0 0 1 8】図 3 に示すように、進角供給油路 2 8 及び遅角供給油路 3 3 には、オイルタンク 3 4 内の作動油をオイルポンプ 3 5 により圧送する圧送路 3 6 とオイルタンク 3 4 内に作動油を排出する排出路 3 7 とが切換弁 3 8 を介して接続され、切換弁 3 8 の切換動作に応じて各供給油路 2 8, 3 3 が圧送路 3 6 及び排出路 3 7 と交互に連通、或いは双方とも遮断される。本実施例ではオイルポンプ 3 5 と切換弁 3 8 により作動油供給手段が構成されている。

【0 0 1 9】次に、本実施例のバルブタイミング調整装置の作動状況を説明する。内燃機関の停止時のベーンロータ 1 2 は、捻りコイルばね 2 0 の付勢力で図 1 に実線で示す最遅角位置に保持されている。機関始動に際して切換弁 3 8 は図 3 に示す位置に切り換えられ、オイルポンプ 3 5 からの作動油は遅角供給油路 3 3、第四油路 3 1、第三油路 3 0 及び遅角導入油路 2 9 を経て遅角油圧室 1 7 a 内に導入され、その油圧は捻りコイルばね 2 0 の付勢力と同方向に作用する。尚、クランクシャフトにて駆動されるオイルポンプ 3 5 の油圧は直ちに上がらないため、ベーンロータ 1 2 を最遅角位置に保持する作用は専ら捻りコイルばね 2 0 が果たす。

【0 0 2 0】始動完了後の切換弁 3 8 は機関回転数や負荷等に基づき制御され、吸気弁の開閉タイミングが機関の運転状態に応じて調整される。例えば、高回転高負荷時にはバルブオーバーラップを増大すべく切換弁 3 8 を図 3 とは逆位置に切り換え、作動油を進角供給油路 2 8、第二油路 2 6、第一油路 2 5 及び進角導入油路 2 3 を経て進角油圧室 1 7 b 内に導入する。その油圧によりベーンロータ 1 2 は捻りコイルばね 2 0 の付勢力に抗して進角側に回転し、所定位置に達したときに切換弁 3 8 を中立に切り換えて、ベーンロータ 1 2 の位置を保持する。

【0 0 2 1】ところで、周知のようにベーンロータ 1 2 には吸気弁を開閉する際の正・負のトルク変動がカムシャフト 3 を介して伝達されるため、捻りコイルばね 2 0 のばね定数としては、撓み量が最も小さい（付勢力が弱い）最遅角位置でもトルク変動に抗してベーンロータ 1 2 を位置保持できるようにある程度大きな値を設定する必要がある。ここで、本実施例では捻りコイルばね 2 0 がハウジング 7 の外周に設けられていることから径が十分に大きく、かつ十分な巻き数を有するため、ベーンロータ 1 2 の回転に伴う捻りコイルばね 2 0 の付勢力の変化は極めて小さい。

【0 0 2 2】つまり、ばね 2 0 の撓み量が最も大きい（付勢力が強い）最進角位置でもその付勢力は油圧によるベーンロータ 1 2 の回転を妨げる虞のない小さな値に

抑制されるため、ベーンロータ 1 2 の回転範囲、換言すれば吸気弁の開閉タイミングの調整範囲として、機関設計上の要求を十分に満たした広い範囲を設定できる。しかも、最進角位置でも捻りコイルばね 2 0 の付勢力がそれほど増大しないため、ベーンロータ 1 2 を高い応答性で回転制御できる。その結果、より適切なタイミング制御を実現して、内燃機関の性能を飛躍的に向上させることができる。

【0 0 2 3】加えて、最進角位置でも捻りコイルばね 2 0 の付勢力が小さな値に抑制されることから、その両端を掛止する掛止孔 4 b や掛止溝 1 9 a の摩耗、或いはタイミングプーリ 4 やばねカバー 1 9 の強度等を特に留意することなく設計できる上に、これらの部材を軽量化して内燃機関の応答性を向上させることができる。一方、周知のように捻りコイルばね 2 0 は同一の曲率を維持して軸心方向（図 2 の左右方向）に巻回成形するため非常に製造し易く、特に厳密な品質管理を要することなく均一なばね定数が得られる。よって、安価なコストで捻りコイルばね 2 0 を製造でき、ひいては調整装置全体の製造コストを低減することができる。

【0 0 2 4】更に、捻りコイルばね 2 0 は前記のように撓みに伴って若干径を変化させるものの、その巻回部分のいずれの箇所も回転中心であるカムシャフト 3 の軸心から常に等距離に位置する。したがって、高回転時の遠心力を受けても巻回部分が半径方向（カムシャフト 3 の軸心と直交する方向）に撓んで重心が偏ることはなく、回転バランスの悪化による種々の弊害、例えば、カムシャフト 3 の回転に伴って軸受部 2 に偏荷重が加わったときのフリクション増大や焼付き、或いはカムシャフト 3 の回転変動による機関の不調や振動発生等を未然に防止することができる。

【0 0 2 5】加えて、捻りコイルばね 2 0 は、圧縮コイルばねのように圧縮時に屈曲してしまう等の予定外の変位を生ずる虞はなく、このような変位で引き起こされる他部材との接触による摩耗や引っかかりによる動作不良等のトラブルを防止することができる。更に、前記のように捻りコイルばね 2 0 の外周側にはばねカバー 1 9 の内周が位置し、内周側にはハウジング 7 の外周が位置していることから、何らかの要因により、捻りコイルばね 2 0 の巻回部分が遠心力で半径方向に撓んだ場合であっても、これらの部材 1 9, 7 で撓みが規制されて重心の偏りは最小限に抑制される。その上、万一捻りコイルばね 2 0 が折損したときでも、ばねカバー 1 9 によりエンジンルーム内への破片の飛散が防止されるため、破片によって引き起こされる機関停止等の二次的なトラブルを未然に回避できる。

【0 0 2 6】（第二実施例）次に、本発明を別のバルブタイミング調整装置に具体化した第二実施例を説明する。尚、前記した第一実施例との相違は、捻りコイルばね 1 0 2 の取付構造にある。よって、共通する構成は同

一番号を付して説明を省略し、相違点を重点的に説明する。

【0027】図4に示すように、シリンダヘッド1の軸受部2にはオイルシール6により閉塞されたばね収容室101が形成され、ばね収容室101内にはカムシャフト3の軸心方向へ同一径で螺旋状に巻回した捻りばね部材としての捻りコイルばね102が配設されている。捻りコイルばね102の一端102aはタイミングプーリ4のボス部4aに形成された掛止溝103内に掛け止めされ、他端102bはカムシャフト3の外周に形成された掛止溝104内に掛け止めされ、この捻りコイルばね102の付勢力により、カムシャフト3はベーンロータ12と共に最遅角位置側に付勢されている。

【0028】詳細はしないがカムボルト105には油路106が貫設され、前記第一実施例と同様に、この油路106等を経て図示しないポンプからの作動油が遅角油圧室17aや進角油圧室17b内に供給されて、ベーンロータ12が遅角側或いは進角側に回動制御される。そして、このようにベーンロータ12の回動付勢に捻りコイルばね102を利用しているため、本実施例では第一

実施例と同様の種々の作用効果を得ることができる。

【0029】ところで、上記第一実施例及び第二実施例では、遅角油圧室17a及び進角油圧室17bの油圧によりベーンロータ12を進角側や遅角側に回動させたが、遅角油圧室17aの油圧は必ずしも作用させる必要はなく、例えば従来技術で説明した特開昭60-175738号公報と同様に、ベーンロータ12の遅角側への回動は捻りコイルばね20、102の付勢力のみで行うように構成してもよい。

【0030】また、上記第一実施例及び第二実施例では、捻りコイルばね20、102を長さ方向全体に同一径で巻回したが、必ずしも全体を同一径とする必要はなく、例えば、第一実施例のハウジング7の外周形状や第二実施例のカムシャフト3の外周形状等に合わせて、捻りコイルばね20、102の径を長さ方向に若干変化させてもよい。

【0031】更に、上記第一実施例では捻りコイルばね20をハウジング7の外周に設け、第二実施例では捻りコイルばね102をカムシャフト3の外周に設けたが、その設置位置は、タイミングプーリ4周辺の部材レイアウトに応じて種々に変更でき、要はタイミングプーリ4と共にクランクシャフトにより回転駆動される部材の外周であればよい。

【0032】また、上記第一実施例では、捻りコイルばね20とハウジング7の外周及びばねカバー19の内周との間に間隔Δ1、Δ2を設けたが、必ずしも各部材20、7、19を常に離間させる必要はなく、相互に接触させてもよい。一方、上記第一実施例及び第二実施例では、吸気弁の開閉タイミングを調整するバルブタイミング調整装置に具体化した但、本発明はこれに限定されるものではなく、吸気弁に代えて排気弁の開閉タイミング、若しくは吸排気弁の開閉タイミングを共に調整するバルブタイミング調整装置として具体化してもよい。更にバルブタイミング調整装置以外の、例えば従来技術で説明した特開昭60-175738号公報のようにディーゼル式内燃機関の燃料噴射タイミングを調整する噴射タイミング調整装置に具体化してもよい。この場合のタイミング調整装置は燃料噴射ポンプの入力軸に設けられ、その入力軸に連結されたカムの位相を機関の運転状態に応じて調整することになる。

【0033】

【発明の効果】以上説明したように本発明のカム位相可変装置によれば、付勢力の変化が小さい捻りばね部材にてベーン部材を回動付勢しているため、その回動範囲を広く設定してカムの位相を広範囲に調整することができる。また、捻りばね部材は均一なばね定数が容易に得られるため製造コストを低減でき、かつ、撓みに伴う重心の偏りがないため、回転バランスの悪化による種々の弊害を未然に防止することができる。

【図面の簡単な説明】

【図1】第一実施例のバルブタイミング調整装置を示す横断面図である。

【図2】第1図のII-II線断面図である。

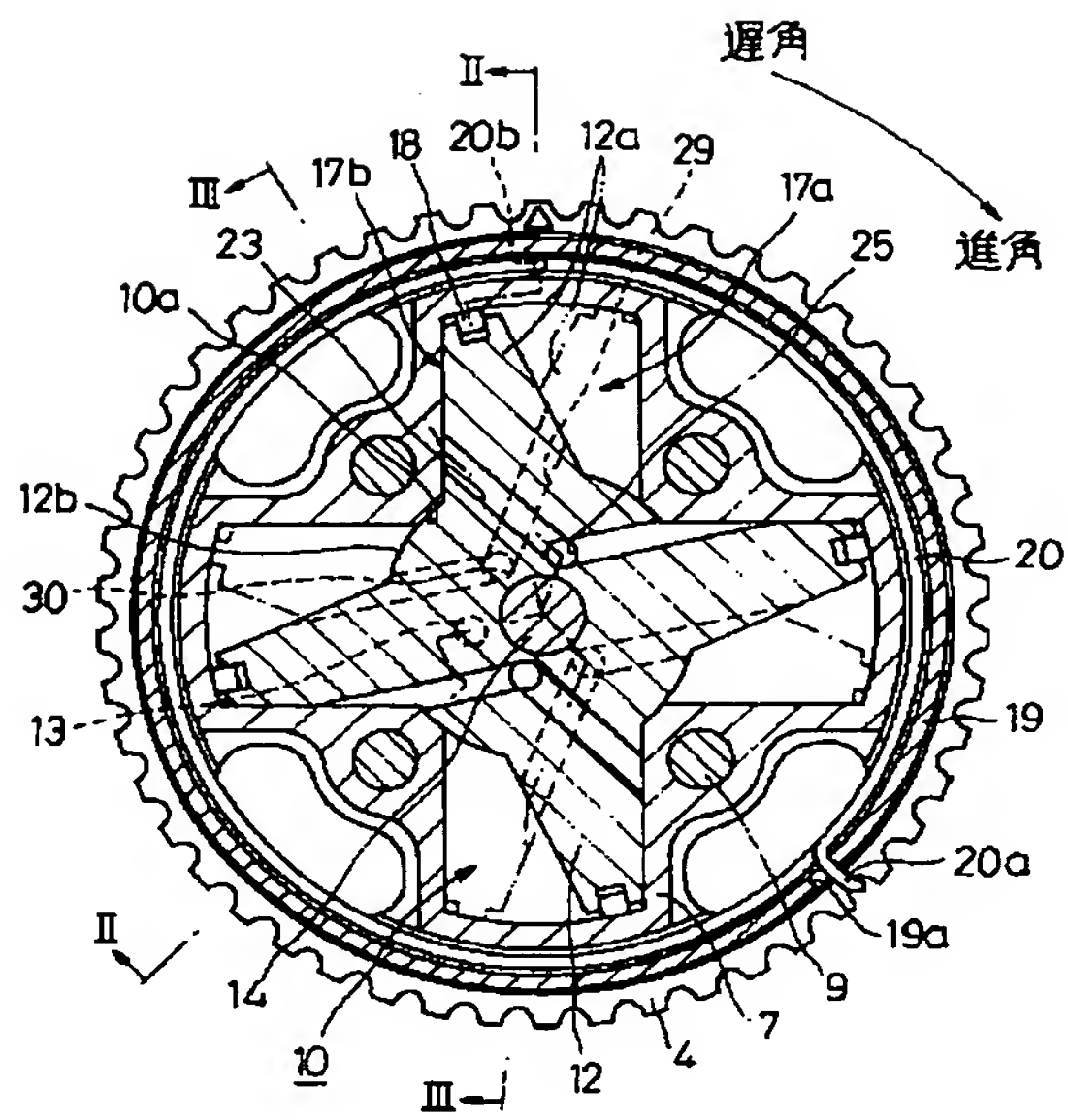
【図3】第1図のIII-III線断面図である。

【図4】第二実施例のバルブタイミング調整装置を示す横断面図である。

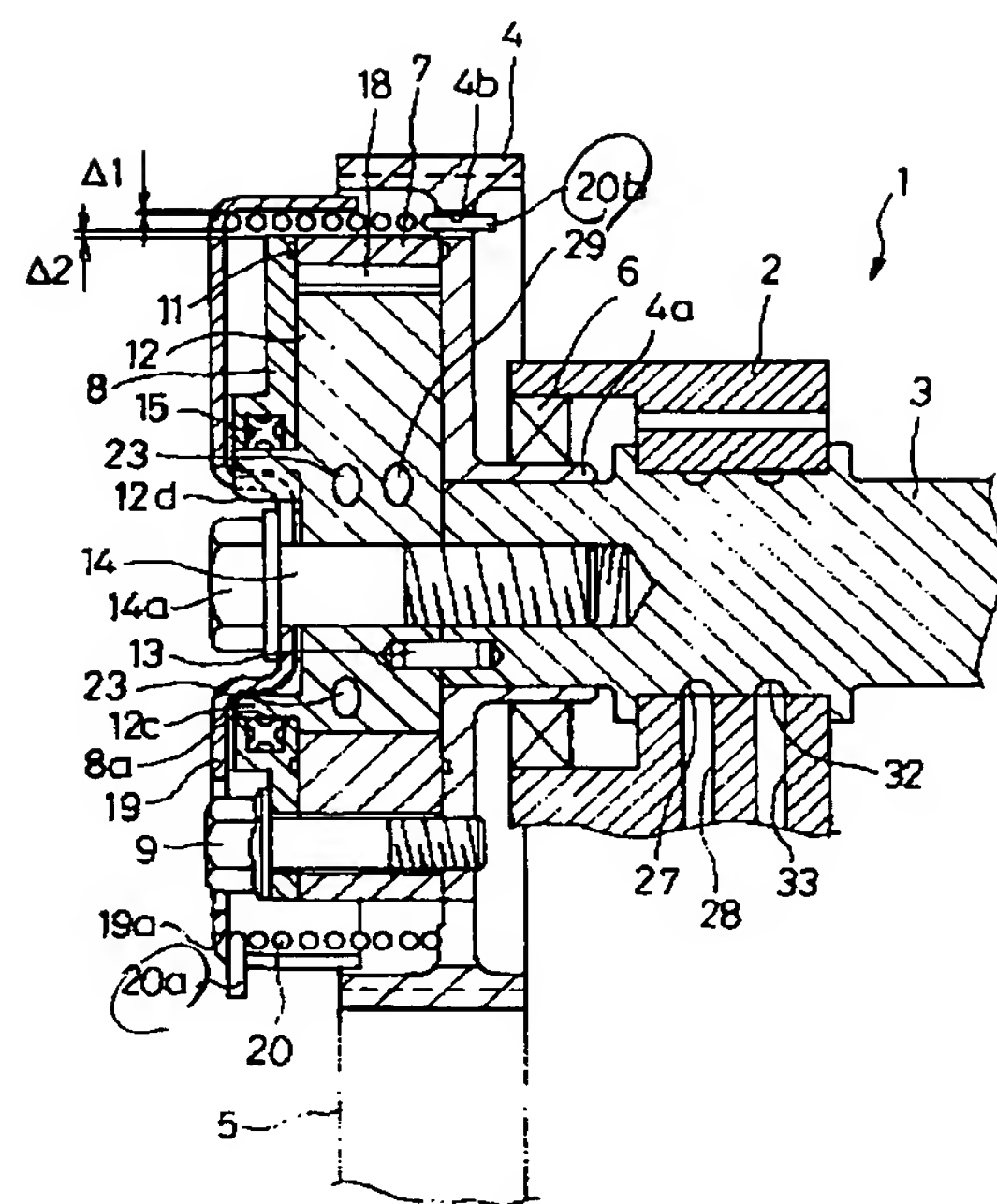
【符号の説明】

3	カムシャフト (カム)
7	ハウジング (収容部材)
8	フロントカバー (収容部材)
12	ベーンロータ (ベーン部材)
17b	進角油圧室 (油圧室)
20, 102	捻りコイルばね (捻りばね部材)
35	オイルポンプ (作動油供給手段)
38	切換弁 (作動油供給手段)

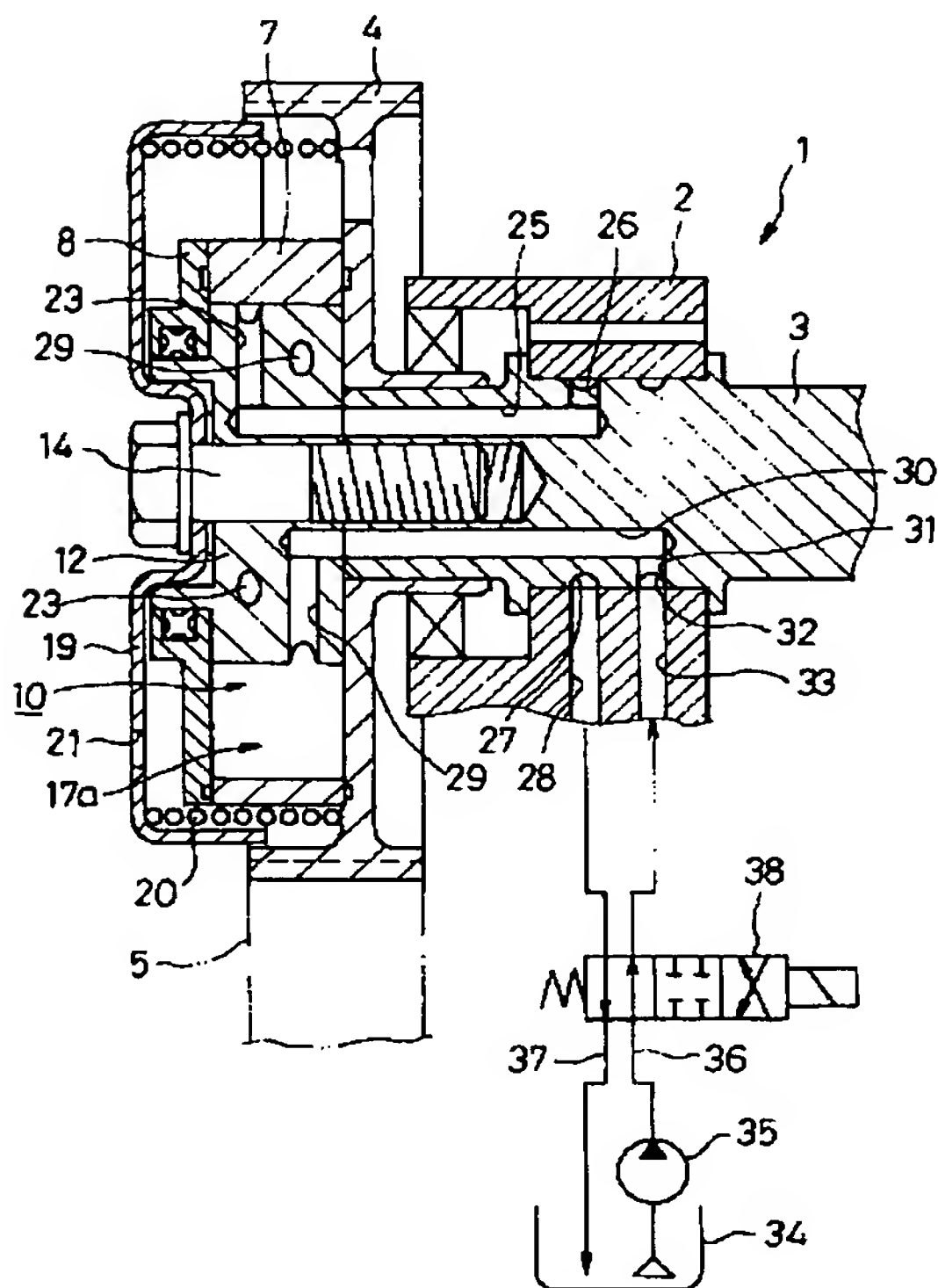
【図 1】



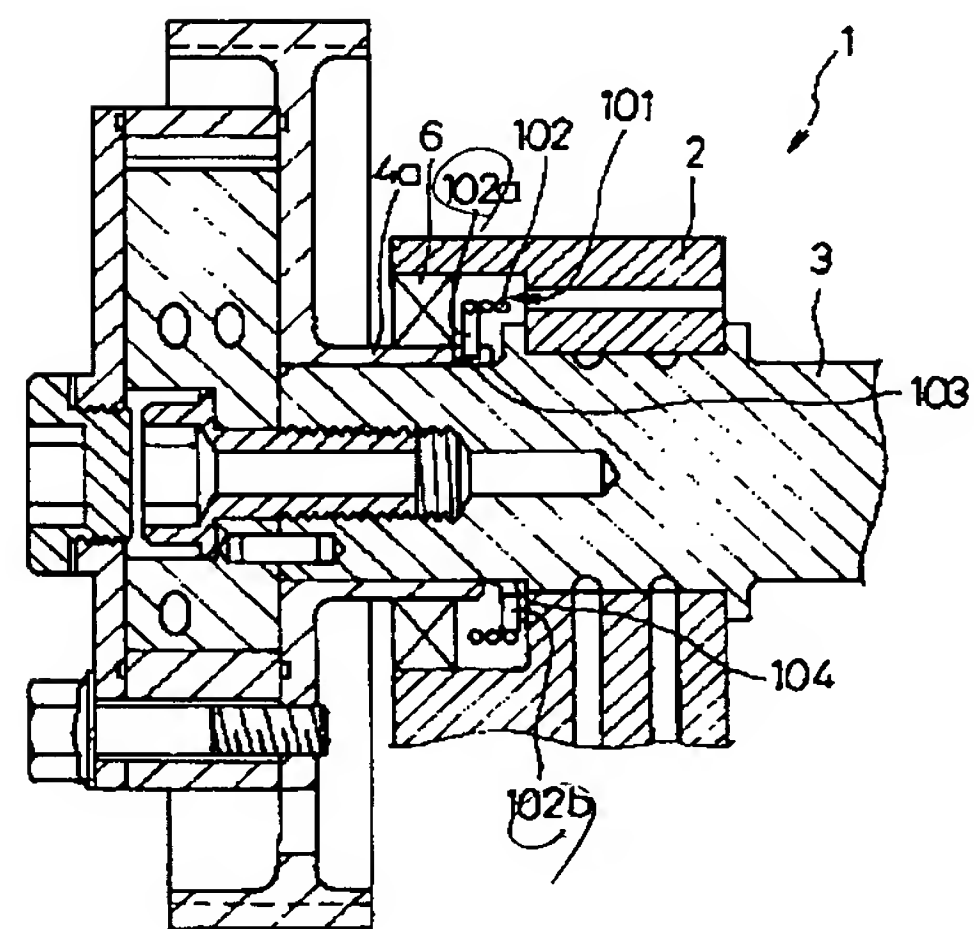
【図 2】



【図 3】



【図 4】



PATENT ABSTRACTS OF JAPAN

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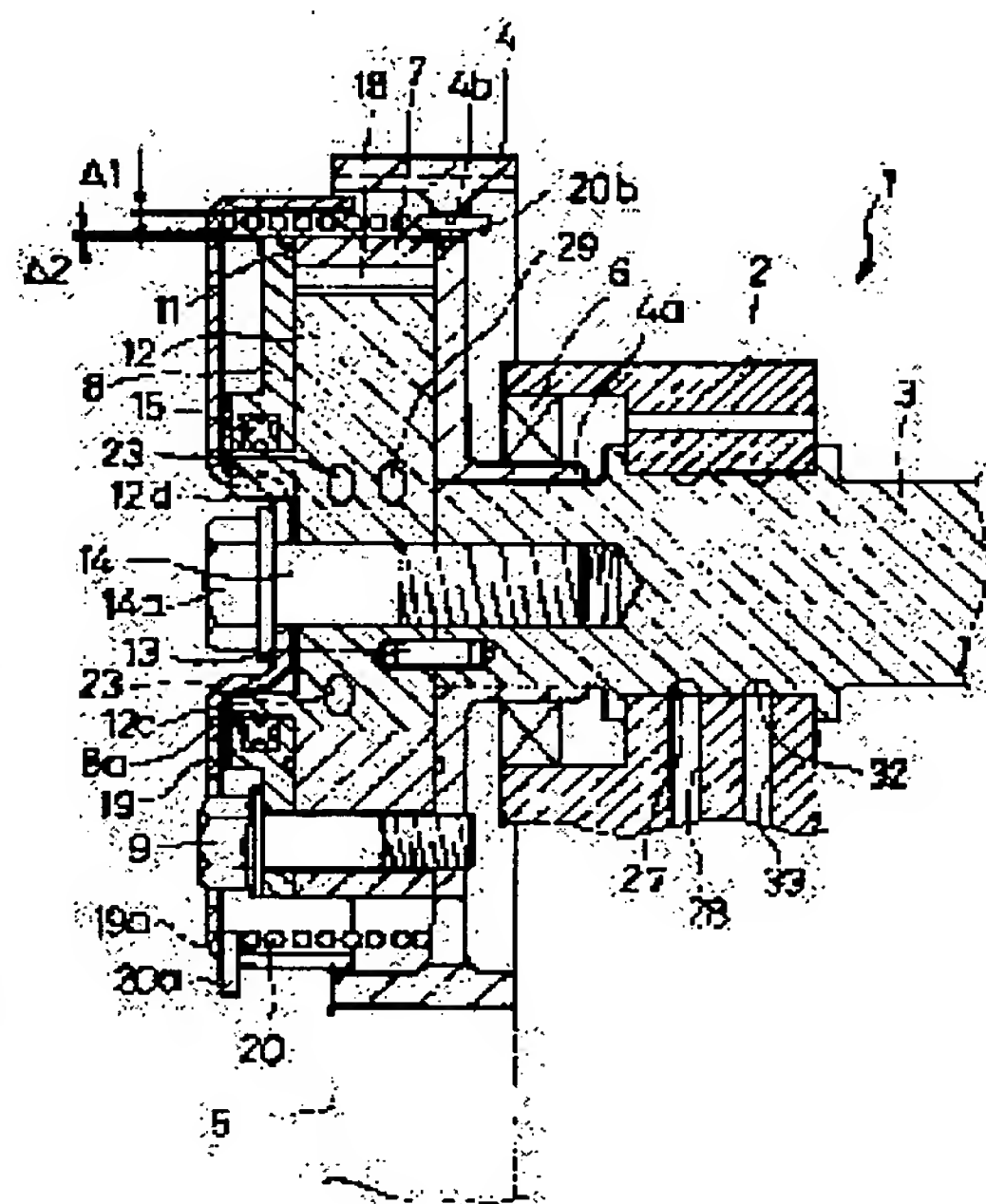
(72)Inventor : MURATA SHINICHI

(54) VARIABLE CAM PHASE DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a variable cam phase device to regulate the phase of a cam throughout a wide range.

SOLUTION: A vane member 12 is arranged in a containing member 7 fixed at a timing pulley 4 and coupled to a cam 3. A twist spring member 20 is disposed at the outer periphery of the containing member 7 and the vane member 12 is rotationally energized to the lag angle side. The cam 3 is rotated in an arbitrary direction together with the vane member 12 by an oil pressure in a hydraulic chamber formed in the containing member 7. The twist spring member 20 is positioned at the outer periphery of the containing member 7 and has a large diameter and the sufficient number of windings, whereby the change of an energizing force is reduced and the rotation range of the vane member 12 is set to a wide range.



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CLAIMS

[Claim(s)]

[Claim 1] it arranges on the same axial center in the hold member in which a rotation drive is carried out by the driving source, and said hold member -- having -- a cam and one -- a hold member -- receiving -- relativity -- with the vane member prepared rotatable It is formed in said hold member and said hold member is received in a vane member with internal oil pressure. The oil pressure room which can give turning effort in the direction of a tooth lead angle, or the direction of a lag, Make the shape of a spiral on the periphery of a hydraulic oil supply means to supply hydraulic oil to said oil pressure room, and one, in which a rotation drive is carried out by said driving source of members in the direction of an axial center, and it is arranged in it to it. Cam phase adjustable equipment characterized by having connected the other end with said hold member side while the end was connected with said vane member side, and equipping the turning effort and hard flow to said direction of a lag by said oil pressure room with the twist spring member which carries out rotation energization of the vane member.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the cam phase adjustable equipment which can adjust the timing of the device which is made to carry out the phase change of the cam, and is driven by the cam of operation.

[0002]

[Description of the Prior Art] The injection timing adjusting device which adjusts the injection timing of the fuel injection pump used for example, for a diesel type internal combustion engine as this conventional kind of cam phase adjustable equipment can be mentioned. Like the publication to JP,60-175738,A, with such an adjusting device, while arranging the input shaft of a fuel injection pump, and the really rotated vane rotor in housing by which a rotation drive is carried out with a crankshaft and energizing the vane rotor to a lag side with the compression coil spring of a pair, the energization force was resisted, the vane rotor was controlled by oil pressure to the tooth-lead-angle side, and desired injection timing has been obtained. And said compression coil spring is infixed between a vane rotor and the holddown member prepared in those both sides, and it consists of this adjusting device so that the energization force may be exerted on a vane rotor.

[0003]

[Problem(s) to be Solved by the Invention] However, with conventional injection timing equipment, since it was restricted between a vane rotor and a holddown member and the spring length of a compression coil spring was not fully able to secure, there was an inclination for the energization force to change suddenly with rotation of a vane rotor. Consequently, when the comparatively big spring constant was set up so that the amount of bending of a spring could carry out station keeping of the vane rotor in the smallest (the energization force is weak) maximum lag location, the energization force in the maximum tooth-lead-angle location became excessive, rotation of the vane rotor by oil pressure was barred, and there was fault that the rotation range of a vane rotor could not be set up widely inevitably.

[0004] It replaces with a compression coil spring like JP,5-296011,A, and the proposal using the spiral spring which demonstrates the energization force stabilized more is also made there. Although the valve timing adjusting device which adjusts the closing motion timing of an internal combustion engine's inlet valve or an exhaust valve according to operational status is indicated by this official report, a spiral spring is arranged in the transverse plane of a timing pulley focusing on the axial center of a cam shaft, that main edge is hung on a vane rotor, a periphery edge is hung on a timing pulley, and the vane rotor is energized.

[0005] However, as everyone knows, it was hard to manufacture a spiral spring in order to carry out winding shaping, changing curvature to radial gradually, and it had the fault that required strict quality control for obtaining a uniform spring constant, and a manufacturing cost soared. Moreover, the conductor spacing of a winding part will tend to change with the change in the amount of bending, it will be promoted with the centrifugal force at the time of high rotation, and a center of gravity will incline. Therefore, there was a possibility of generating an engine's bad condition, oscillating generating, etc. by the various evils by aggravation of rotation balance, for

example, friction increase of cam-shaft bearing, and printing or rotation fluctuation of a cam shaft.

[0006] The purpose of this invention is to offer the cam phase adjustable equipment which can manufacture at cheap cost and can prevent the various evils by aggravation of rotation balance beforehand while being able to reach far and wide and adjust the phase of a cam.

[0007]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, in this invention, a cam and the vane member rotated by one are arranged in the hold member in which a rotation drive is carried out by the driving source. While twisting on one periphery of the members by which a rotation drive is carried out, such as this hold member, cam, etc., arranging a spring member and carrying out rotation energization of the vane member, the turning effort of hard flow is given to a vane member with the oil pressure of the oil pressure room formed in the hold member, and a cam is rotated with a vane member. And since a twist spring member is prepared in peripheries, such as a hold member and a cam, in this way and it has a certain amount of path, a uniform spring constant is further obtained from a twist spring member carrying out winding shaping in the direction of an axial center by a setup becoming it being large and possible about the rotation range of a vane member by change of the energization force becoming small, and there is no bias of the center of gravity accompanying bending.

[0008] This invention can be suitably materialized as a valve timing adjusting device which adjusts the closing motion timing of an internal combustion engine's inlet valve or an exhaust valve. Namely, the hold member by which a rotation drive is carried out with an internal combustion engine's crankshaft according to this invention, it arranges on the same axial center in said hold member -- having -- the cam shaft for valve-opening close, and one -- a hold member -- receiving -- relativity -- with the vane member prepared rotatable. It is formed in said hold member. With internal oil pressure The oil pressure room which can give turning effort to a vane member in the specific direction, Make the shape of a spiral on the periphery of a hydraulic oil supply means to supply hydraulic oil to said oil pressure room, and one by which a rotation drive is carried out with said crankshaft of members in the direction of an axial center, and it is arranged in it to it. While an end is connected with said vane member side, the other end is connected with said hold member side, and the valve timing adjusting device characterized by equipping the turning effort and hard flow by said oil pressure room with the twist spring member which carries out rotation energization of the vane member is offered.

[0009]

[Embodiment of the Invention] (The first example) The first example which materialized this invention hereafter to the valve timing adjusting device which adjusts the closing motion timing of an internal combustion engine's inlet valve is explained. As shown in drawing 1 and drawing 2, it is supported by shaft orientations at migration impossible, and the closing motion drive of that the cam shaft 3 of the inspired air flow path as a cam is pivotable and the inlet valve which each gas column does not illustrate with rotation of a cam shaft 3 is carried out at the bearing 2 of an internal combustion engine's cylinder head 1. The front end of a cam shaft 3 is projected from the cylinder head 1 to the side, boss section 4a of the timing pulley 4 is inserted in rotatable, this timing pulley 4 is connected with the crankshaft which is not illustrated as a driving source through a timing belt 5, and a rotation drive is carried out in the direction of an arrow head of drawing 1 a core [the axial center of a cam shaft 3]. Although illustration is not carried out, the timing pulley of an exhaust side is also connected with a timing belt 5, and the closing motion drive of the exhaust valve is carried out in the cam shaft of an exhaust side. In addition, oil seal 6 was inserted in between boss section 4a of the timing pulley 4, and bearing 2, and the outflow of the oil from the cylinder head 1 to the exterior is prevented.

[0010] The approximately cylindrical housing 7 as a hold member and the disc-like front cover 8 are fixed to one side face of the timing pulley 4 with a bolt 9, the abbreviation cross-joint-like oil pressure room 10 centering on the axial center of a cam shaft 3 is formed in it to the interior, and an oiltight is held with O ring 11. In the oil pressure room 10, the vane rotor 12 as a vane member is arranged, and the core is positioned by the front end of a cam shaft 3 with a dowel pin 13, and is being fixed to it with the cam bolt 14.

[0011] The vane rotor 12 is equipped with four vane 12a at intervals of 90 degrees, movable slide contact side 12b of the shape of radii which contacts fixed slide contact side 10a of the oil pressure room 10 is formed between each vane 12a, and oil seal 18 is formed at the tip of each vane 12a. The oil pressure room 10 is divided by these slide contact sides 10a and 12b four corresponding to each vane 12a, and lag oil pressure room 17a and tooth-lead-angle oil pressure room 17b as an oil pressure room are formed in each oil pressure room 10 of them at the both sides of vane 12a.

[0012] And the maximum lag location which the vane rotor 12 makes the 1 side of each vane 12a contact the wall of the oil pressure room 10 at drawing 1 as a continuous line shows, and makes max the volume of lag oil pressure room 17a, Between the maximum tooth-lead-angle locations which a side besides each vane 12a is made to contact the wall of another side of the oil pressure room 10, and make max the volume of tooth-lead-angle oil pressure room 17b as an imaginary line shows, the axial center of a cam shaft 3 may be rotated as a core. Consequently, the phase of the cam shaft 3 to the timing pulley 4 changes, and the closing motion timing of an inlet valve is changed. In addition, since an exhaust side is not equipped with such a valve timing adjusting device, the closing motion timing of an exhaust valve is fixed.

[0013] Annular seal section 12c which encloses head 14a of the cam bolt 14 is really formed in the vane rotor 12, and the seal section 12c is inserted in rotatable in Shilu 8a installed through the front cover 8, and is having the oiltight held by X ring 15. The spring covering 19 puts on a front cover 8 from the side, and while the core of the spring covering 19 is ***** (ed) with said cam bolt 14 in the center of annular seal section 12c of the vane rotor 12, rotation is regulated in 12d of positioning projected parts formed in annular seal section 12c.

[0014] The spring covering 19 makes the shape of a closed-end cylinder, conceals a front cover 8 and housing 7 from the exterior, and twists them between the inner circumference of the spring covering 19, and the periphery of housing 7, and the twist coiled spring 20 as a spring member is arranged. The twist coiled spring 20 is spirally wound in the direction of an axial center of a cam shaft 3 with the diameter of the same, and its axial center of this twist coiled spring 20, housing 7, and the spring covering 19 corresponds with the axial center of a cam shaft 3. End 20a of the twist coiled spring 20 is hung in hanging slot 19a of the spring covering 19, a stop is carried out, other end 20b is hung in hanging hole 4b of said timing pulley 4, a stop is carried out, and the vane rotor 12 is energized by the energization force with the spring covering 19 at the maximum lag location side always shown in drawing 1 as a continuous line.

[0015] In addition, although the twist coiled spring 20 has the property to change an outer diameter a little in connection with bending Even when the amount of bending twists by min and coiled spring 20 expands the diameter most in this example The minute spacing delta 1 is secured between the inner circumference of the spring covering 19, and even when it bends conversely, an amount twists at the maximum and coiled spring 20 reduces the diameter most, the bore of the spring covering 19 and the outer diameter of housing 7 are set up so that the minute spacing delta 2 may be secured between the peripheries of housing 7.

[0016] On the other hand, the balance adjustment hole 21 is formed in the 1 side of the spring covering 19, and balance adjustment is performed by this balance adjustment hole 21 in the state of the assembly before attachment by the condition 1 which connected the valve timing adjusting device with the cam shaft 3 with the cam bolt 14, i.e., the cylinder head. As shown in drawing 1 and drawing 3, four tooth-lead-angle installation oilways 23 an end carries out [the oilways] opening to the vane rotor 12 into tooth-lead-angle oil pressure room 17b, respectively are formed, and opening of the other end of each tooth-lead-angle installation oilway 23 is carried out into the application oil groove 27 formed in the periphery perimeter of a cam shaft 3 through the first oilway 25 and the second oilway 26, and it is always open for free passage [other end] irrespective of angle of rotation of a cam shaft 3 to the tooth-lead-angle supply oilway 28 formed at said bearing 2.

[0017] Similarly four lag installation oilways 29 an end carries out [the oilways] opening to the vane rotor 12 into lag oil pressure room 17a, respectively are formed, and through the third oilway 30 and the fourth oilway 31, opening of the other end of each lag installation oilway 29 is carried out into the application oil groove 32 of a cam shaft 3, and it is always open for free

passage [other end] irrespective of angle of rotation of a cam shaft 3 to the lag supply oilway 33 formed at bearing 2.

[0018] As shown in drawing 3 , the feeding way 36 which feeds the hydraulic oil in an oil tank 34 by the oil pump 35, and the exhaust passage 37 which discharges hydraulic oil in an oil tank 34 are connected through a change-over valve 38, and each supply oilways 28 and 33 are intercepted the feeding way 36 and exhaust passage 37, and by turns for a free passage or both sides by the tooth-lead-angle supply oilway 28 and the lag supply oilway 33 according to change-over actuation of a change-over valve 38. The hydraulic oil supply means is constituted from this example by the oil pump 35 and the change-over valve 38.

[0019] Next, the actuation situation of the valve timing adjusting device of this example is explained. The vane rotor 12 at the time of a halt of an internal combustion engine is held in the maximum lag location shown in drawing 1 as a continuous line by the energization force of the twist coiled spring 20. On the occasion of engine starting, a change-over valve 38 is switched to the location shown in drawing 3 , the hydraulic oil from an oil pump 35 is introduced in lag oil pressure room 17a through the lag supply oilway 33, the fourth oilway 31, the third oilway 30, and the lag installation oilway 29, and the oil pressure acts in the energization force and this direction of the twist coiled spring 20. In addition, in order that the oil pressure of the oil pump 35 driven with a crankshaft may not go up immediately, the twist coiled spring 20 achieves chiefly the operation which holds the vane rotor 12 in the maximum lag location.

[0020] The change-over valve 38 after the completion of starting is controlled based on an engine rotational frequency, a load, etc., and the closing motion timing of an inlet valve is adjusted according to an engine's operational status. For example, a change-over valve 38 is switched to a reverse location with drawing 3 that a valve overlap should be increased at the time of a high rotation heavy load, and hydraulic oil is introduced in tooth-lead-angle oil pressure room 17b through the tooth-lead-angle supply oilway 28, the second oilway 26, the first oilway 25, and the tooth-lead-angle installation oilway 23. The vane rotor 12 resists the energization force of the twist coiled spring 20 with the oil pressure, and it rotates to a tooth-lead-angle side, when a predetermined location is arrived at, a change-over valve 38 is switched to neutrality, and the location of the vane rotor 12 is held.

[0021] By the way, since the forward and negative torque fluctuation at the time of opening and closing an inlet valve is transmitted to the vane rotor 12 through a cam shaft 3 as everyone knows, it is necessary to set up a to some extent big value so that torque fluctuation may be resisted and the station keeping of the vane rotor 12 can be carried out as a spring constant of the twist coiled spring 20 also in the maximum lag location where the amount of bending is the smallest (the energization force is weak). Here, in this example, since it twists, coiled spring 20 is formed in the periphery of housing 7 and a path has sufficient number of turns greatly enough, change of the energization force of the twist coiled spring 20 accompanying rotation of the vane rotor 12 is very small.

[0022] That is, since the energization force is controlled by the small value without a possibility of barring rotation of the vane rotor 12 by oil pressure, if it puts in another way, it can set up the rotation range of the vane rotor 12, and the large range which fully filled the demand on an engine design as an adjustable range of the closing motion timing of an inlet valve also in the maximum tooth-lead-angle location where the amount of bending of a spring 20 is the largest (the energization force is strong). And since it twists also in the maximum tooth-lead-angle location and the energization force of coiled spring 20 does not increase so much, the rotation control of the vane rotor 12 can be carried out by high responsibility. Consequently, more suitable timing control can be realized and an internal combustion engine's engine performance can be raised by leaps and bounds.

[0023] In addition, since it twists also in the maximum tooth-lead-angle location and the energization force of coiled spring 20 is controlled by the small value, it can design upwards, without minding especially wear of hanging hole 4b which hangs the both ends, or hanging slot 19a, the timing pulley 4, the reinforcement of the spring covering 19, etc., these members can be lightweight-ized, and an internal combustion engine's responsibility can be raised. On the other hand, it twists as everyone knows, and in order that coiled spring 20 may maintain the same

curvature and may carry out winding shaping in the direction of an axial center (longitudinal direction of drawing 2), a uniform spring constant is obtained that it is very easy to manufacture, without requiring strict quality control especially. Therefore, it can twist at cheap cost, and coiled spring 20 can be manufactured, as a result the manufacturing cost of the whole adjusting device can be reduced.

[0024] Furthermore, although the twist coiled spring 20 changes a path a little in connection with bending as mentioned above, it is always located in the equal distance from the axial center of the cam shaft 3 any part of whose of the winding part is the center of rotation. Therefore, even if it receives the centrifugal force at the time of high rotation, an engine's bad condition, oscillating generating, etc. by the friction increase and printing when a winding part bending in radial (direction which intersects perpendicularly with the axial center of a cam shaft 3), a center of gravity not inclining, and an unbalanced load joining bearing 2 with the various evils by aggravation of rotation balance, for example, rotation of a cam shaft 3, or rotation fluctuation of a cam shaft 3 can be prevented beforehand.

[0025] In addition, there is no possibility of 20 twist coiled spring of producing the unexpected variation rate of being crooked like a compression coil spring at the time of compression, it is caused with such a variation rate, and also it can prevent troubles, such as wear by contact to a member, and a malfunction by connection. Furthermore, since the inner circumference of the spring covering 19 is located in the periphery side of the twist coiled spring 20 as mentioned above and the periphery of housing 7 is located in an inner circumference side, even if it is the case where the winding part of the twist coiled spring 20 is bent by the centrifugal force in radial, bending is regulated by a certain factor by these members 19 and 7, and the bias of a center of gravity is controlled to the minimum. Since scattering of the fragment into an engine room is moreover prevented by the spring covering 19 even when the twist coiled spring 20 should break, secondary troubles, such as an engine halt caused with a fragment, are beforehand avoidable.

[0026] (The second example) Next, the second example which materialized this invention to another valve timing adjusting device is explained. In addition, the attachment structure of the twist coiled spring 102 has the difference with the first above mentioned example. Therefore, a common configuration attaches the same number, omits explanation, and explains difference preponderantly.

[0027] As shown in drawing 4 , the spring hold room 101 blockaded with oil seal 6 is formed in the bearing 2 of the cylinder head 1, and the twist coiled spring 102 as a twist spring member spirally wound in the direction of an axial center of a cam shaft 3 with the diameter of the same is arranged in the spring hold room 101. End 102a of the twist coiled spring 102 is hung in the hanging slot 103 formed in boss section 4a of the timing pulley 4, a stop is carried out, other end 102b is hung in the hanging slot 104 formed in the periphery of a cam shaft 3, a stop is carried out, and the cam shaft 3 is energized by the energization force of this twist coiled spring 102 with the vane rotor 12 at the maximum lag location side.

[0028] Although not carried out for details, an oilway 106 is installed by the cam bolt 105, the hydraulic oil from the pump which is not illustrated through this oilway 106 grade is supplied like said first example in lag oil pressure room 17a or tooth-lead-angle oil pressure room 17b, and rotation control of the vane rotor 12 is carried out at a lag or tooth-lead-angle side. And since it twisted to rotation energization of the vane rotor 12 in this way and coiled spring 102 is used, in this example, the same various operation effectiveness as the first example can be acquired.

[0029] By the way, although the vane rotor 12 was rotated to the tooth-lead-angle and lag side in the first example of the above, and the second example with the oil pressure of lag oil pressure room 17a and tooth-lead-angle oil pressure room 17b Like JP,60-175738,A which the oil pressure of lag oil pressure room 17a did not need to be made to not necessarily act, for example, was explained with the conventional technique, you may constitute so that rotation by the side of the lag of the vane rotor 12 may be performed only by the energization force of the twist coiled spring 20,102.

[0030] Moreover, in the first example of the above, and the second example, although the twist coiled spring 20,102 was wound in the whole die-length direction with the diameter of the same, it is not necessary to necessarily make the whole into the diameter of the same for example, and

the path of the twist coiled spring 20,102 may be changed in the die-length direction a little according to the periphery configuration of the housing 7 of the first example, the periphery configuration of the cam shaft 3 of the second example, etc.

[0031] furthermore, although twisted, coiled spring 20 was formed in the periphery of housing 7, it twisted in the second example and coiled spring 102 was formed in the periphery of a cam shaft 3 in the first example of the above, the installation location should just be the periphery of the member by which can change into versatility according to the member layout of the timing pulley 4 circumference, and a rotation drive is carried out with a crankshaft with the timing pulley 4 in short.

[0032] Moreover, although spacing delta 1 and delta 2 was formed between the periphery of the twist coiled spring 20 and housing 7, and the inner circumference of the spring covering 19, it is not necessary to make each part material 20, 7, and 19 always not necessarily estrange, and you may make it contact mutually in the first example of the above. On the other hand, although shape was taken in the first example of the above, and the second example to the valve timing adjusting device which adjusts the closing motion timing of an inlet valve, this invention is not limited to this and may be materialized as a valve timing adjusting device which replaces with an inlet valve and adjusts both the closing motion timing of an exhaust valve, and the closing motion timing of an induction-exhaust valve. Furthermore, shape may be taken to the injection timing adjusting device which was explained for example, with the conventional techniques other than a valve timing adjusting device and which adjusts a diesel type internal combustion engine's fuel-injection timing like JP,60-175738,A. The timing adjusting device in this case will be formed in the input shaft of a fuel injection pump, and the phase of the cam connected with that input shaft will be adjusted according to an engine's operational status.

[0033]

[Effect of the Invention] Since change of the energization force is carrying out rotation energization of the vane member in the small twist spring member according to the cam phase adjustable equipment of this invention as explained above, the rotation range can be set up widely and the phase of a cam can be adjusted broadly. Moreover, since a twist spring member can reduce a manufacturing cost since a uniform spring constant is obtained easily, and it does not have the bias of the center of gravity accompanying bending, the various evils by aggravation of rotation balance can be prevented beforehand.

[Translation done.]